EXPO 2021
engineering ▲ design

INFRASONIC WILDFIRE DETECTION

TEAM FIREWATCH

OBJECTIVE

Create a set of prototypes for a resilient mesh network of affordable devices that can detect infrasound. These devices must have a rigid construction capable of surviving long drops.

BACKGROUND

Wildfires emit infrasound, which is inaudible sound with a frequency from 0 to 20 Hz.

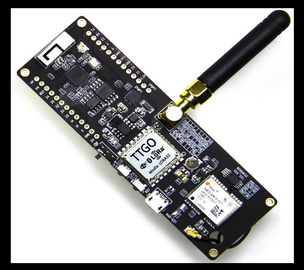
There is research precedent for detecting infrasonic acoustic waves generated by wildfire using electret condenser microphone sensors.

VALUE PROPOSITION

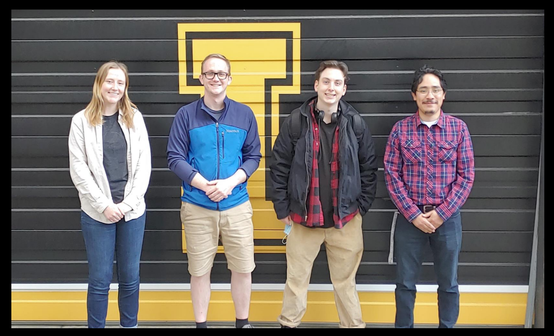
A robust network of affordable sensor devices has the potential to save lives and property by quickly identifying wildfires.

DEVELOPMENT BOARD

- ESP-32 Processor
- LORA-32 915 MHz Radio
- NEO-6M GPS
- AXP-192 Power Controller
- 18650 Battery Source
- UART, SPI, I2C Communication



TEAM MEMBERS



MERIDIAN HAAS, CORY HOLT,
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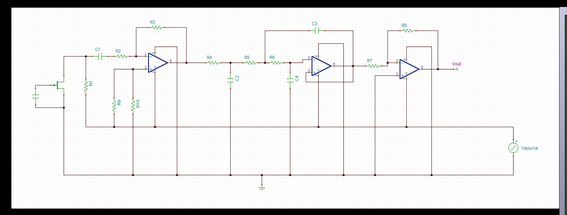
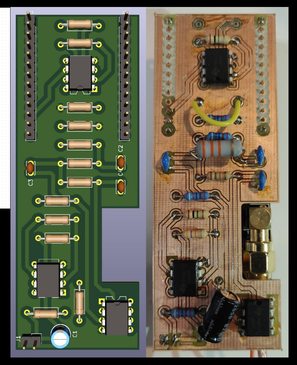
ELECTRICAL DESIGN



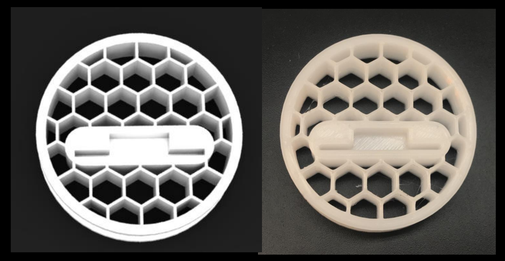


- Power supplied by Dev. Board
- Microphone Preamplifier
- 3rd Order Chebyshev Low-Pass Filter
- 741 Operational Amplifiers

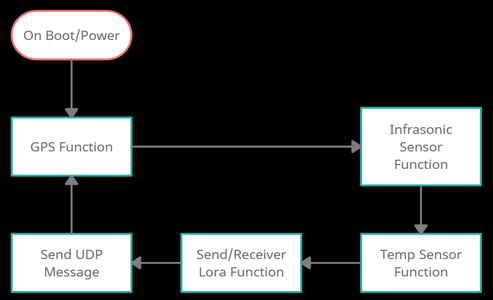
ENCLOSURE DESIGN

- Robust Enclosure made of 2in SCH 40 PVC
- End caps create a water-resistant seal
- Holes for antenna and microphone
- Press fit shock absorber

- Shock Absorber is 3D printed in flexible TPU filament
- Honeycomb design for stability and dampening

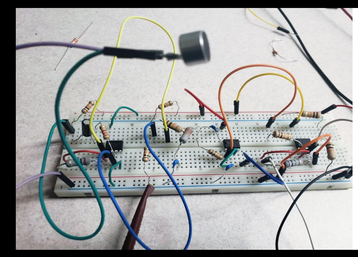


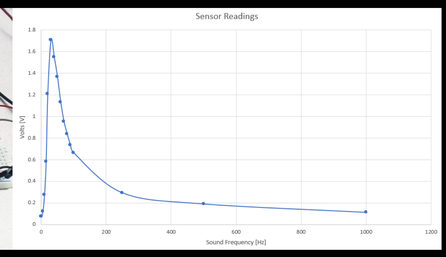
SOFTWARE DESIGN



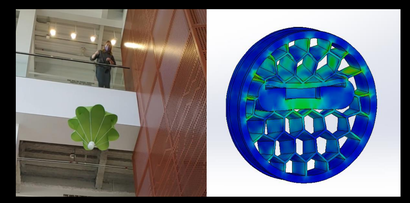
- A block diagram of the current software implementation for "smart nodes," as well as "dumb nodes" that don't send UDP messages.
- Currently structured to be a forever loop.

VALIDATION

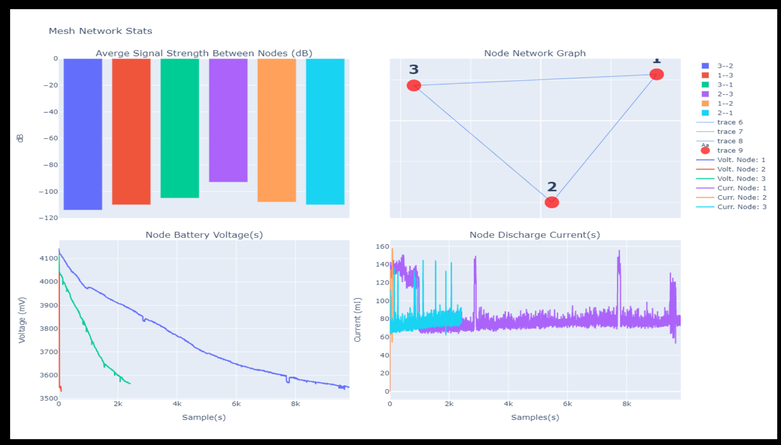




- Bread board infrasound sensor and frequency response.



- Parachute drop test performed inside the IRIC
- Shock Absorber Force Simulation



- Mesh Visualization Tool (MVT)

CONCLUSIONS

We created a set of basic prototypes that relay messages between each other. The Mesh Visualization Tool (MVT) gives insight into how the network behaves. The enclosure design protects and holds all electronics. Additionally, we designed and validated a working infrasound sensor. However, this project is far from complete. Future teams can improve upon: Power Management, Node Networking, Digital Signal Processing, and the usage of a RTOS.

Special Thanks to:

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